

NO. 1.

MEMOIRS
OF THE
KYANCUTTA MUSEUM
Kyancutta, South Australia.

New Species of Archaeocyathinae
and other organisms

From the LOWER CAMBRIAN of Beltana, South Australia.

By

R. and W. R. Bedford.

MARCH

1934.

Memoirs of the Kyancutta Museum.

MEMOIRS OF THE KYANCUTTA MUSEUM, Kyancutta, South Australia.

No. 1, March 1934.

NEW SPECIES OF ARCHAEOCYATHINAE, etc., by R. and W. R. Bedford.

CORRIGENDA.

P. 4, Col. 1, L. 53, for ACANTHOCYATHIDAE read ACANTHINOCYATHIDAE.

P. 4, Col. 2, L. 8, for Acanthocyathus read Acanthinocyathus.

Plate III., for Acanthocyathus read Acanthinocyathus.

Plate V., for reteseptatus read reteseptatum.

Plate VI., for 34. Heterocyathus minor read 34. Heterocyathus major.

P. 5, Col. 2, L. 36, for reticulate read reticulata.

P. 6, Col. 1, L. 57, for reteseptatus read reteseptatum.

P. 7, Col. 1, L. 6, for Heterocythus read Heterocyathus.

GENOTYPES of new Genera described are as follows:

Monocyathus porosus,

Ethmocyathus lineatus,

Acanthinocyathus apertus,

Pinacocyathus spicularis,

Metafungia reticulata,

Metacyathus Taylori,

Metacoscinus reteseptatum,

Heterocyathus minor,

Uranosphaera polyaster,

all the above being new species at the time of publication.

Australia.

MARCH, 1934.

EOCYATHINAE

n of Beltana, South Australia.

By R. and W. R. Bedford.

T. Griffith Taylor, in Memoirs of the Royal Society of South Australia, Vol. 2 part 2 (Adelaide 1910), described a number of Archaeocyathinae from this and other localities. As a result of collections made by us last year we are able to add 32 new species, 8 new genera and 4 new families, including some forms of considerable morphological interest. All the specimens described are from the Lower Cambrian limestone of the Ajax Mine, Beltana. We desire to express our indebtedness to and our appreciation of Professor Taylor's monograph, which forms the basis on which we have added, and to which we would refer the reader for general anatomical features of the group.

Considerations of expense have compelled us to condense our descriptions, and have made it impossible to publish photographs of the specimens. The accompany-

ing drawings are somewhat diagrammatic; for convenience of comparison all are enlarged to a uniform scale of four to one. The specimens are all silicified (though presumably calcified originally), enabling the details to be exposed by successive grindings on an emery wheel and etchings with hydrochloric acid. In most cases the organism is shown in transverse section (Tr. S. in sketches), tangential longitudinal section (Ta.L.S.) grazing the outer wall (O.W.), a similar view of inner wall (I.W.), and radial longitudinal section (Ra.L.S.) grazing the septa. The tangential sections are purposely somewhat oblique, so that, for example Fig. 12 shows successively the underlying septa and a tabula, the wall-pores, pores and papillae, and finally the tips of the papillae lying free in the matrix filling the central cavity. The limestone matrix is shown black in all the sketches.

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Family MONOCYATHIDAE (new family).

Conical single-walled tubes, with numerous circular pores, very uniform and regularly arranged in the typical species.

Monocyathus porosus (Taylor's "Archaeolynthus") Fig. 1.

A conical tube, often somewhat waved by gentle annular constrictions; average diameter 6 mm. Wall thin, (.2mm.), pierced by very uniform and regularly arranged pores; the pores are spaced about two to the mm., are circular, and alternate as the rows are traced longitudinally but form a square pattern as the rows are traced diagonally; this is the most usual arrangement of pores in the inner wall of normal Archaeocyathinae. One specimen was noticed in which the rim at wider end is folded inwards to a depth of a little over 1mm. and about the same distance inwards from the wall; this suggests that the wall may correspond to the outer wall of Archaeocyathinae.

This form is tentatively assigned by Taylor to the sponges. The wall, however, is not sponge-like, and is almost identical with that of many normal Archaeocyathinae, and particularly with the outer wall of *Dokidocyathus* (Taylor).

Monocyathus irregularis (new species). Fig. 2.

Tubular; average diameter 3mm. Wall thin (.2mm.), waved by annular constrictions. Circular pores, irregular in size, about one to the mm.; a pore often occupies the centre of a small circular papilla. The resemblance to the wall of an Archaeocyathus is much less than in the preceding species; we place it in this genus provisionally.

Family ARCHAEOCYATHIDAE (Taylor).

Archaeocyathus subacutus (new species). Fig. 3.

Conical tube. Intervallum coefficient 3mm.: 6mm. (the first figure gives the intervalum width, the second figure the diameter of central cavity). Septa numerous (about 50), .6mm. apart. Outer wall has small circular pores, one row to intercept, .3mm. apart. Septal pores appear to be confined to a single row of rather large pores, about .5mm. apart, close to junction with outer wall; but we are not quite certain on this point. Inner wall; large circular pores, regularly alternating, one row to intercept, about .5mm. apart. The regular alternation of the large pores of inner wall gives a very characteristic appearance to the inner ends of the septa as seen in transverse section; and also in tangential section where they become sinuous as they approach the inner wall.

Taylor describes a similar but unsilicified form "in a friable limestone . . . the finer details of the structure not well preserved" which he assimilates to Bornemann's *Archaeocyathus acutus*, saying that the material is not satisfactory enough to found a new species upon. Our specimens are silicified and well preserved, but it is impossible to say whether they correspond with Taylor's. We use the name "subacutus" to preserve the association with Taylor's provisional correlation of his specimens.

Archaeocyathus floreus (new species). Fig. 4.

Conical tube; intervalum coefficient 2mm.: 4mm.; the cone tapers downwards to a minute spitz, retaining its characteristic structure, and without sign of root tissue. The outer wall bulges out longitudinally between the septa, giving a fluted exterior to the cone; there are about six defined vertical rows of small pores to each intercept. The septa are very remote, ten in number at 8mm. diameter; there is sometimes a vertical row of septal pores close to the junction with outer wall, about the same size as those of outer wall, and we have seen occasional pores (some of larger size) farther away from the outer wall. The inner wall has two or three rows of rather large pores to the intercept. The species agrees with *Archaeocyathus Rensselaericus* (Ford) in the fluting of outer wall.

Archaeocyathus magnipora (new species). Fig. 7.

Conical Tube; intervalum coefficient 2mm.: 4mm. Septa fairly remote, about 18 in number at 8mm. diameter. Outer wall; numerous small and rather irregular pores. Inner wall; a single row of large pores to each intercept. Septa with large circular pores of various sizes. A very scarce species.

Archaeocyathus retevallum (new species). Fig. 6.

Conical, expanding to an irregular cup; intervalum coefficient 3mm.: 20mm. Septa very numerous and closely set (.5mm.) Outer wall; a row of small pores to each intercept. Inner wall a spongy mesh, .7mm. thick, passing with no definite perforated membrane into the central cavity. Septal pores not identified. The species is scarce, only one colony of three individuals having been found, in brown limestone.

Archaeocyathus tracheodentatus (new species). Fig. 5.

Conical tube; intervalum coefficient 2mm.: 7mm. Outer wall not well seen, no pores being visible (perhaps from secondary silicification). Septa very numerous and closely set (.4mm.); pores visible close to outer wall, and perhaps elsewhere. The inner wall has a row of circular pores to each intercept, and strong annular shelves projecting into the central cavity, each shelf giving off into the central cavity a regularly arranged series of spines. This structure is exactly intermediate between two of Taylor's species, *Archaeocyathus trachealis* and *Ethmocyathus dentatum*, having shelves like the former, and spines like the latter, but being without the vesicular wall of the latter. A scarce species.

Ethmocyathus lineatus (new genus and species). Fig. 8.

The unique specimen of this very interesting form has an inner wall which is quite unlike that of any other member of the Phylum. The septa curve at their inner ends and become united to form a regular honeycomb of small square cells, diagonally arranged, each cell being about .4mm. across and .5mm. deep. The inner face of this honeycomb is crossed by an extremely fine grating of minute, horizontal, annular bars, about ten to 1mm. The organism is conical; intervalum coefficient 2mm.: 10mm. Septa very numerous and closely set (.4mm.) Outer wall; numerous extremely fine pores about four rows to intercept. Septal pores fine and numerous.

Pycnoidocyathus maximipora (new species). Fig. 9.

The type fragment is part of a nearly cylindrical cup. The outer surface shows annular bulges 20 to 25mm. apart, the inner surface remaining cylindrical. The intervallum varies from 12mm. in the bulges to 6mm. elsewhere, the central cavity being 25mm. across. The septa are straight, about 50 in number and 2mm. apart. The outer wall is a spongy network, which is 2mm. thick in the bulges, but does not reach anything like the thickness seen in *Pycnoidocyathus simplex* (Taylor). The septal pores are oval, very large, and numerous. The inner wall has very large pores, 2mm. across, leading upwards and inwards into the central cavity.

Another fragment of a similar but larger cup, which must have reached 80mm. in diameter, has an intervallum of 25mm. It agrees with the foregoing in most respects, but the spongy outer wall terminates externally in a more definitely porous layer than that shown in Fig. 9c, the pores being about .25mm. diameter and closely set (two to the mm.) Possibly this is the normal form of outer wall for the species.

Family COSCINO CYATHIDAE (Taylor).

Coscinoocyathus rugosus (new species). Fig. 11.

A rapidly expanding cone; intervallum coefficient 2mm.: 1.5mm., giving a very small central cavity. Septa sixteen in number at 6mm. diameter, but only twelve reach the inner wall. The outer wall has two or three vertical ridges to each intercept, directed outwards, the hollows being occupied by vertical rows of small pores. Two tabulae exposed are 1.5mm. apart. The material is insufficient to define further detail. Only one specimen has been found.

Coscinoocyathus papillatus (new species). Fig. 12.

Conical tube; intervallum coefficient 4mm.: 7mm. Pores of outer and inner walls about equal in size, three to 1mm. Outer wall pores three alternating rows to intercept. Inner wall pores two alternating rows to intercept; each pore has a little tooth or papilla projecting inwards into central cavity, giving the inner surface of the wall the appearance of a nutmeg grater. Septa 32 in number at 15mm. diameter, about 1.5mm. apart; numerous fine pores. Tabulae 3 to 10mm. apart; numerous fine pores. Three or four specimens have been found.

Coscinoocyathus textilis (new species). Below Fig. 11.

Gently tapering cone in lower part, rapidly expanding above. Intervallum coefficient 2mm.: 8mm. Septa about 40 in number at 14mm. diameter, about 1mm. apart in expanded portion; numerous fine pores. In one specimen dissepimental tissue is present. The pores of outer wall, two to 1mm., are polygonal, two rows to an intercept, often with an internal vertical ridge between the two rows; these pores are much larger than those of the inner wall, an unusual feature which is characteristic of the species. Pores of inner wall very small and numerous, four to 1mm.

Coscinoocyathus quadratus (new species). Fig. 10.

Conical; intervallum coefficient 3mm.: 7mm. Septa very numerous and close, .7mm. apart, with numerous

fine pores. Tabulae also very numerous and close, .5 to 1mm. apart, numerous fine pores. The tabulae are therefore as close as the septa, giving a loculus square in tangential section; this is the only Australian *Coscinoocyathus* having this feature. Outer wall; two or three rows of very fine pores to the intercept. Inner wall not well seen; thick, with two rows of irregular pores to intercept. Only one specimen found.

Coscinoocyathus Petersi (new species). Fig. 13.

Conical, with sharp vertical flutings to outer wall, giving a stellate cross section, which is the characteristic feature of the species; intervallum coefficient 2.5mm.: 4mm. Septa eighteen at 9mm., numerous fine pores. Tabulae 2.5mm. apart, numerous fine pores. Outer wall; each intercept projects strongly to form a sharp vertical ridge; fine circular pores. Inner wall; fine horizontal shelves project upwards and inwards into the central cavity; a horizontal row of very small pores between each pair of shelves. Only one specimen has been found, but it is very clear and well defines the species; it was identified by Mr B. J. Peters, technical assistant to the Kyan-cutta Museum, after whom we have named it.

Coscinoocyathus retifer (new species). Fig. 14.

Conical; intervallum coefficient 2mm.: 4mm. Septa 20 in number at 8mm. diameter. Tabulae remote (? 10mm. or more apart), thin; very numerous small pores. The outer wall has about five rows of very small pores to intercept, four pores to 1mm. The inner wall is thick with one or two rows of rather large pores to the intercept, two pores to 1mm.; two pores often coalesce to form a horizontal slit with bars above and below. The finely porous outer wall at once distinguishes the species from *C. australis* (Taylor). Only one specimen found.

Coscinoocyathus cribripora (new species). Fig. 15.

Lower part a tapering cone, upper part expanding to a broad nearly flat rim, 100mm. across; intervallum coefficient 2mm.: 7mm. in lower part. Septa about 32 in number at 11mm. diameter; numerous fine pores. Tabulae 3 to 5mm. apart; numerous fine pores. The outer wall has two rows of large pores to the intercept, each pore being closed by a thin plate with about seven minute perforations; this is a distinguishing feature of the species. The inner wall has one or two rows of large circular pores to each intercept in the lower part; two rows to each intercept in the rim. The species is very scarce.

Coscinoocyathus Cellularis (new species). Fig. 16.

Long tapering cone; the wall in our specimen is folded inwards in a long vertical fold, encroaching largely on the central cavity; intervallum coefficient 4mm.: 13mm. Septa very numerous, .7mm. apart; minute pores arranged in about 14 vertical rows in each septum. Tabulae very numerous, 1.5mm. apart; very numerous minute pores. Outer wall; two rows of small pores to the intercept; there are indications that the pores are covered by a thin membrane with very minute pores (compare *C. cribripora*). The pores of inner wall are slightly larger than those of outer; they form an irregular mosaic with little or no trace of lineal arrangement, and each fits its neighbours so as to leave only a narrow partition between them. Very scarce species.

Coscinoocyathus annulatus (new species). Fig. 17.

The shape is conical or (?) tubular; intervallum 5mm; central cavity (?) about 8mm. Septa very numerous, about .5mm. apart, with very numerous fine circular pores. Tabulae very numerous, 1.5mm. apart, with very numerous minute circular pores. The outer wall is not well seen in our specimen. Inner wall; the characteristic feature is the regular quadrate arrangement of the pores, one to each intercept, with the horizontal rows of partitions between the pores prolonged to form annular shelves projecting inwards into the central cavity. The species differs from *C. aulax* (Taylor) in the wider intervallum and the much more numerous tabulae. Only one fragment has been found.

Coscinoocyathus papillipora (new species). Fig. 18.

Conical; intervallum coefficient 1.5mm : 4mm. Septa 26 in number at 7mm. diameter, with numerous fairly large pores. Tabulae remote (? 10mm. or so apart), with numerous small pores. The outer wall has one or two rows of very characteristic pores per intercept, each pore entering a hollow hemispherical papilla projecting outwards from the wall, with an external perforation in the lower part of the papilla. The inner wall is also very characteristic; each intercept has a single row of thick-walled tubular pores leading upwards and inwards into the central cavity. Only one specimen has been found of this very remarkable little *Coscinoocyathus*, but it is in excellent condition and clearly defines the species.

Coscinoptycha unilinearis (new species). Fig. 19.

Only a more or less flat fragment, about 30 x 20mm., is preserved. The intervallum is exceedingly narrow, probably less than 1mm. Septa very delicate, regular and numerous, .5mm. apart, with numerous fine pores. One wall is very characteristic, with a single very regular line of pores occupying the centre of each intercept; the pores are often more or less elongated in the longitudinal direction. The other wall has two rows of very fine pores to the intercept. From the small fragment it is impossible to be sure which wall is outer and which inner; but the slight curvature favours the coarse-pored wall as being the outer. The tabulae are from 2 to 5mm. apart.

Note:—After this account was prepared for the press another fragment was found which clearly shows the coarse-pored wall as being the outer one. This fragment is a small cone, with numerous roots, which rapidly expands into an almost flat disc; roots also proceed from the lower surface of the disc. The intervallum is 1mm.; tabulae from 1mm. to 4mm. apart. The distance from centre of cone to edge of fragment is 40mm. Although the species resembles Taylor's *Coscinoptycha convoluta*, the narrow intervallum and closely set tabulae are points of distinction which it would be unsafe to ignore.

Family ACANTHOCYATHIDAE (new family). Figs. 20, 21.

This new group is a very interesting one. The specimens agree with normal *Archaeocyathinae* in the possession of two walls; these are united by a very scanty framework of delicate radial rods, similar to the arrangement seen in *Dokidocyathus simplicissimus* (Taylor). The distinctive feature is that the outer wall, instead of consisting of a definite lamina perforated by pores, or of

a fine spongy mesh, is built up, as it were, of a series of fused spicular elements enclosing large open spaces. We are not in a position ourselves to discuss the morphological significance of these forms, or their bearing on the evolution of *Archaeocyathinae* and Sponges, but we hope that their discovery will be of service to specialists working on the phylogeny of both these Phyla.

Acanthocyathus apertus (new genus and species). Fig. 20.

Conical tube; intervallum coefficient 5mm : 7mm. Outer wall a very coarse structure, apparently composed of fused triradiate spicular elements, enclosing pores from 1 to 3mm. diameter, the smaller pores being in the smaller specimens or in those obscured by considerable secondary silicification; the median limb of each spicular element is prolonged into a spinous process which is directed upwards and which projects slightly outwards from the general level of the wall (the side parts of the drawing fig. 20a rather exaggerate this projection). The inner wall consists of a very open network enclosing large pores which average 2mm. diameter; the pores are polygonal (usually hexagonal) with rounded corners, and the network consists of round rods about .7mm. diameter. The inner and outer walls are connected by scattered radial rods, circular in section, anastomosing with the walls at rather remote intervals. The drawing fig. 20b shows the outer wall and radial connecting elements in radial longitudinal section; the central cavity has been ground away, exposing the curved surface of the inner wall. The species is not very scarce, several specimens having been found.

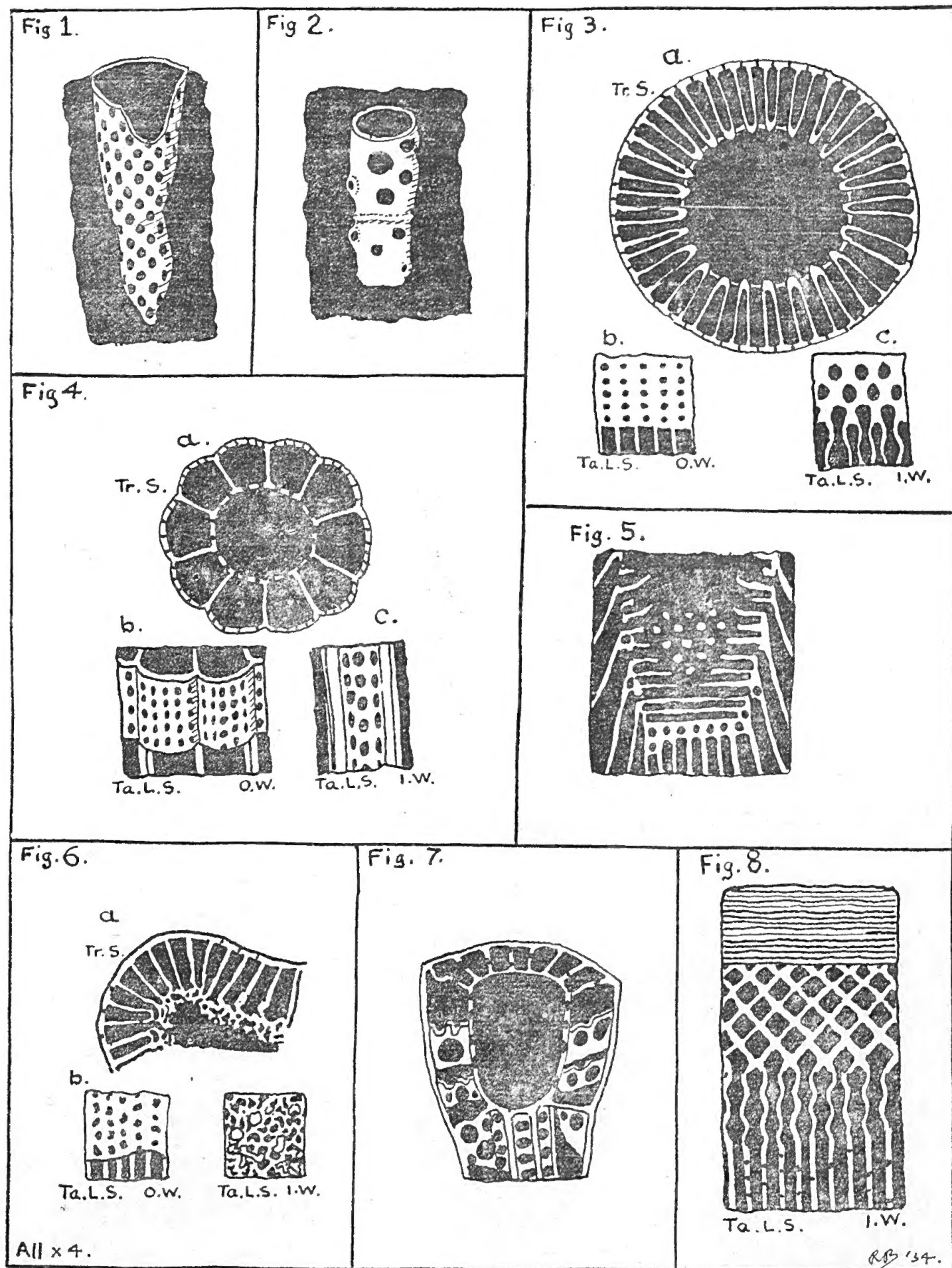
Pinacocyathus spicularis (new genus and species). Fig. 21.

Conical tube; intervallum coefficient 2mm : 2mm. The outer wall consists of an open network, the rods forming this being about .4mm. diameter; the principal members are a series of about 12 vertical rods evenly spaced around the circumference of the wall; these rods, whilst for the most part lying at the periphery, dip occasionally a short distance inwards; they are united by short cross members which more frequently lie horizontally but may be inclined; in grinding away the surrounding matrix it was noticed that a few very short branch rods projected outwards from the wall, but these projections were for the most part lost in the further grinding and etching necessary to expose the wall. The inner wall cannot be fully seen without damaging the specimen; apparently it consists of an open network like that of *Acanthocyathus*, but on a smaller scale, with pores about 1mm. diameter. As in the other member of the family the two walls are connected by scattered radial rods. In the lower part of the specimen there is an indication of the above mentioned structure passing into an irregular less open network. Unfortunately this interesting form is very scarce, only one specimen having been found; but it is in excellent condition and enables the structure to be defined with certainty.

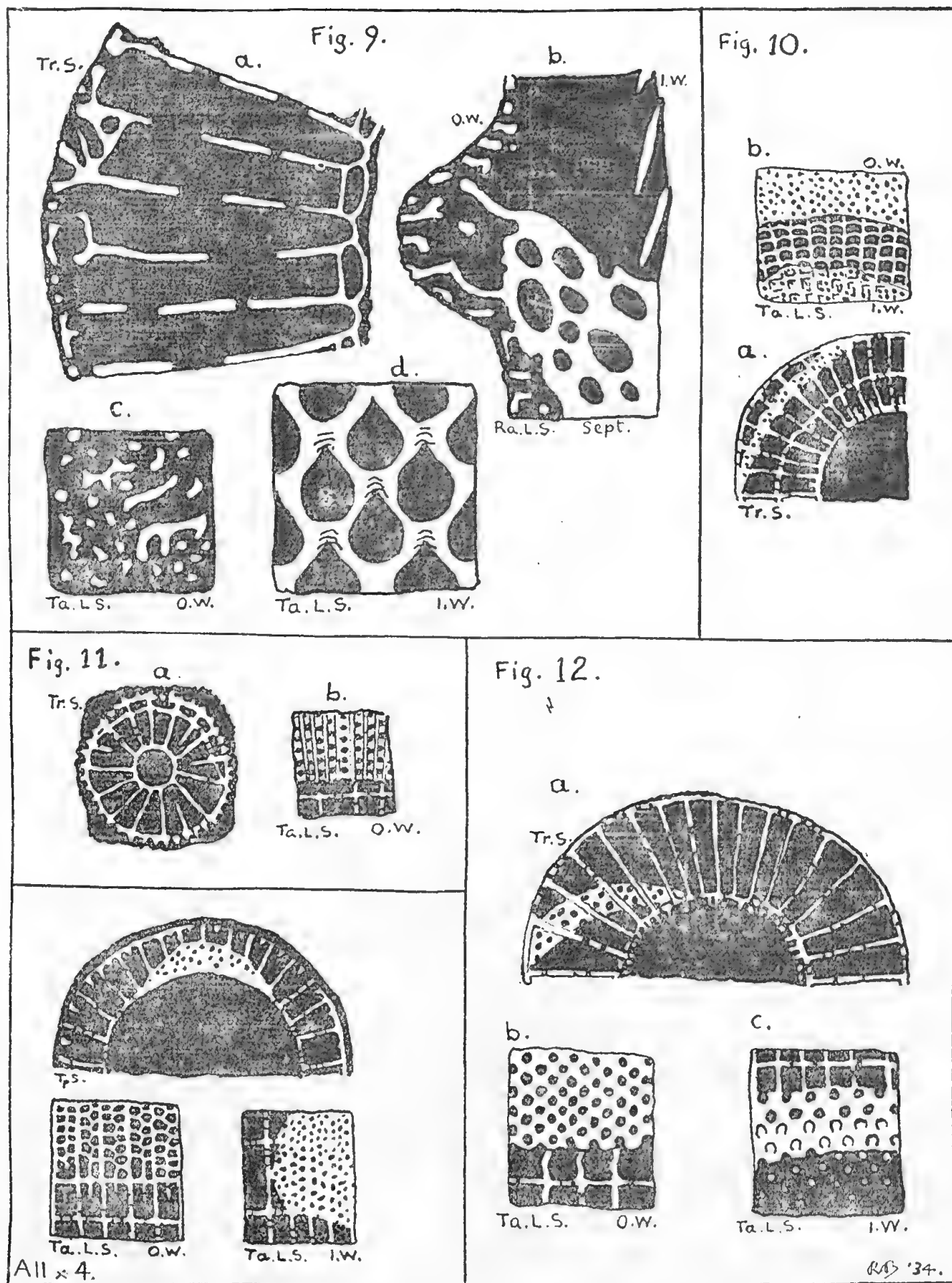
Family SPIROCYATHIDAE (Taylor).

Protopharetra graphica (new species). Fig. 22.

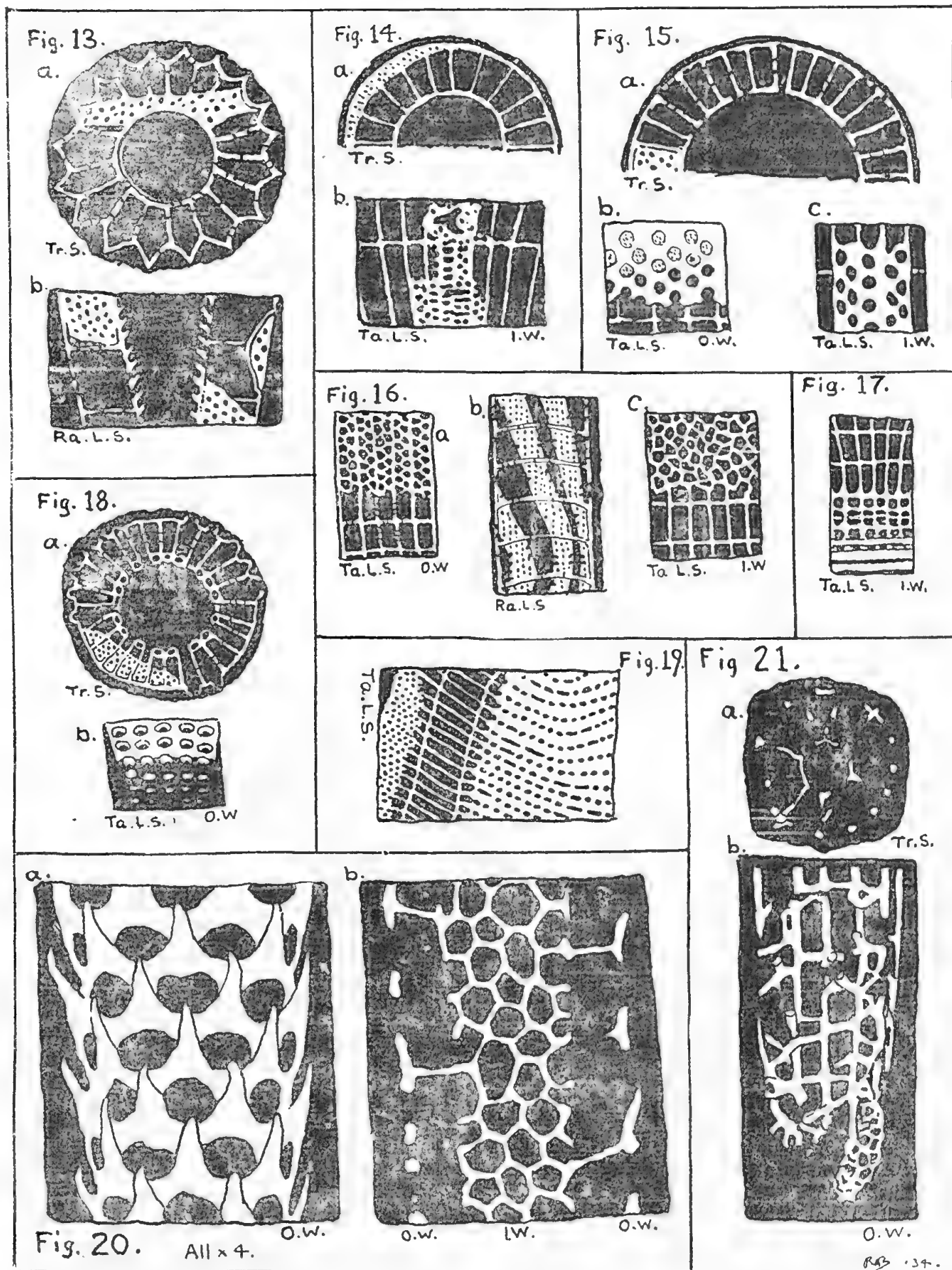
Conical tube; surface waved by irregular annular bulges and constrictions, the inner wall following the waves of outer wall, thus maintaining a fairly uniform interval-



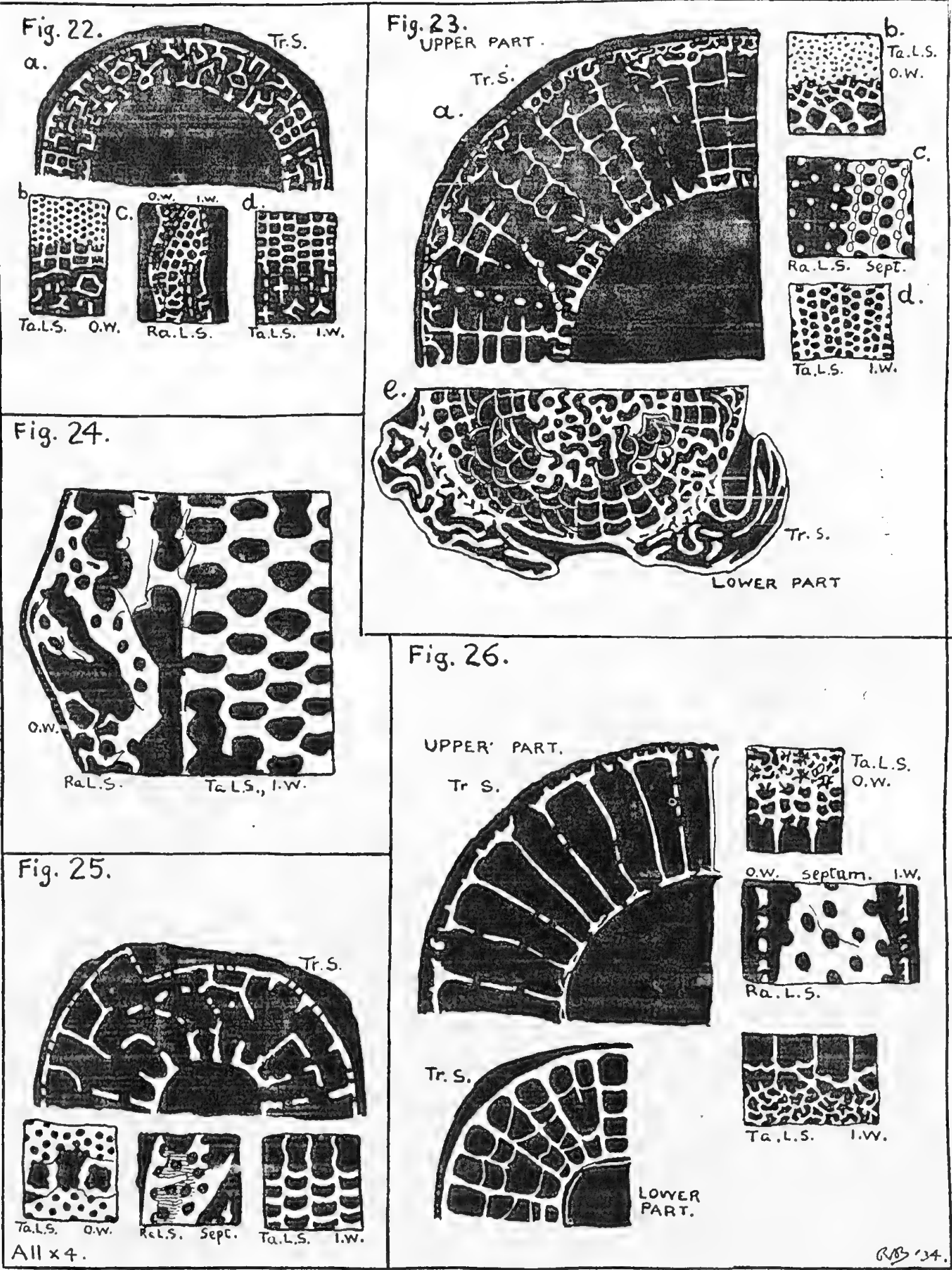
1. Monocyathus porosus. 2. Monocyathus irregularis. 3. Archaeocyathus subacutus. 4. Archaeocyathus florens. 5. Archaeocyathus tracheodentatus. 6. Archaeocyathus retevallum. 7. Archaeocyathus magnipora. 8. Ethmocyathus lineatus.



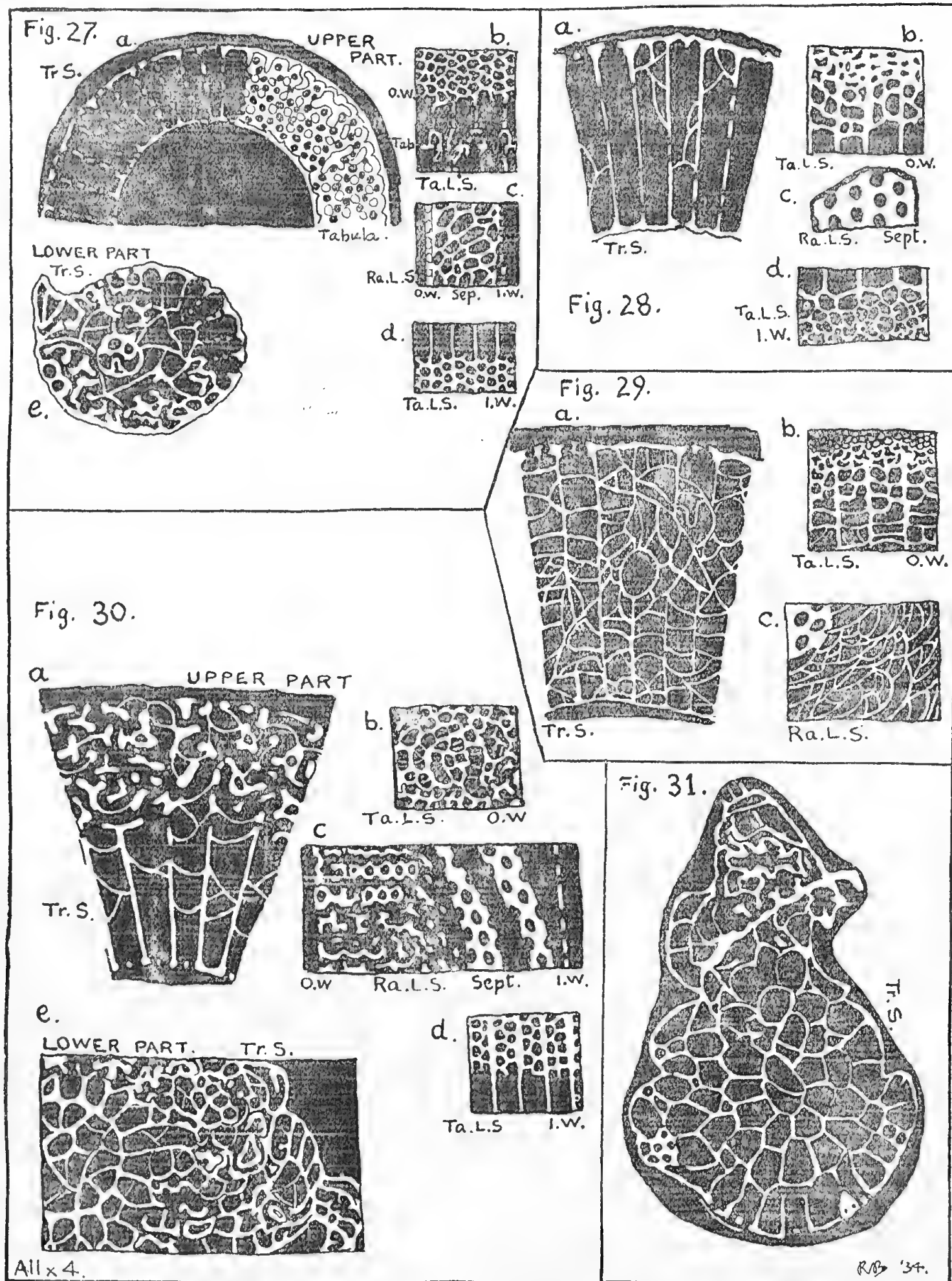
9. *Pycnocyathus maximipora*. 10. *Coscinocyathus quadratus*. 11. *Coscinocyathus rugosus*. 12. *Coscinocyathus papillatus*. Below fig. 11. *Coscinocyathus texilis*.



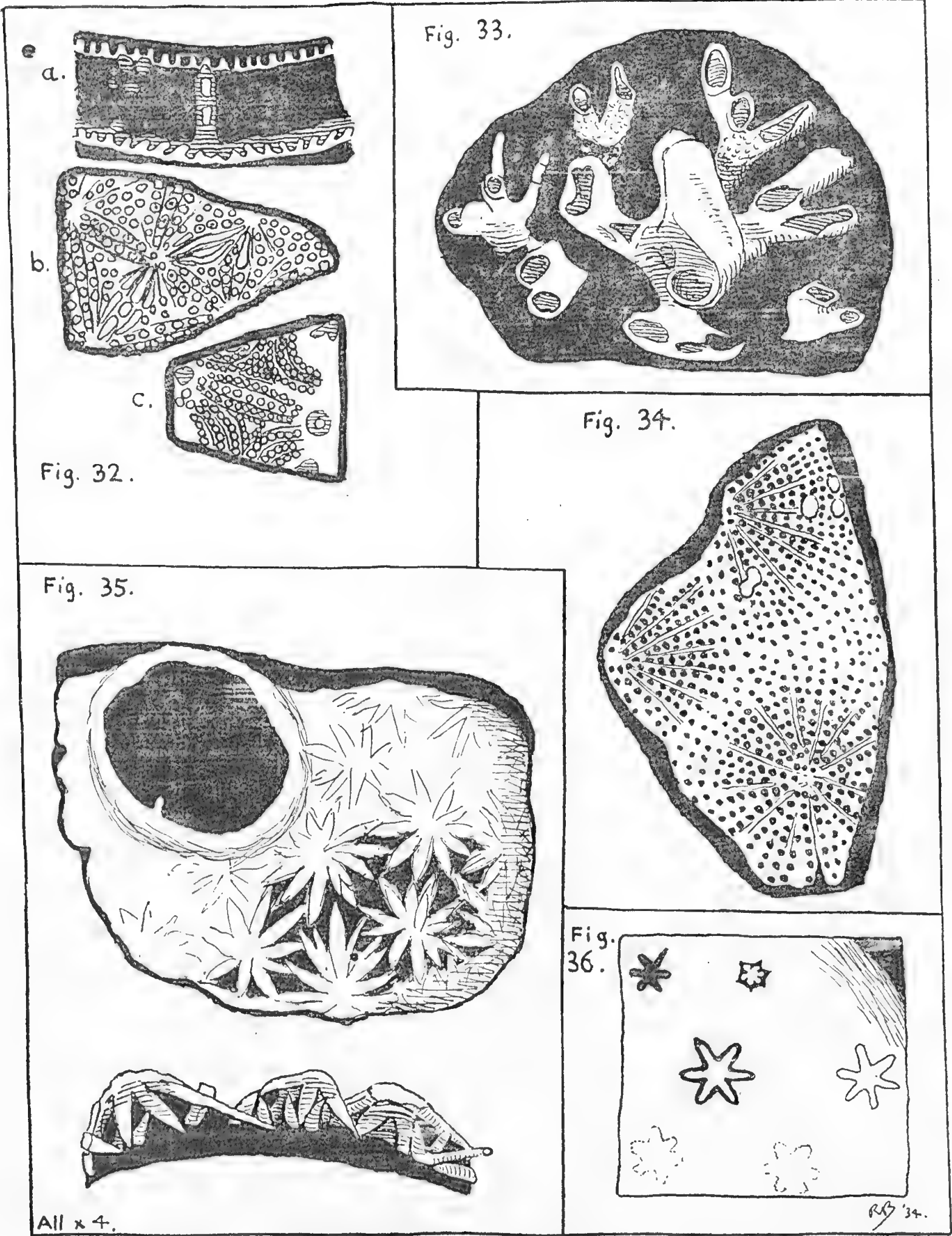
13. *Coscinocyathus Petersi*. 14. *Coscinocyathus retifer*. 15. *Coscinocyathus cribripora*. 16. *Coscinocyathus cellularis*. 17. *Coscinocyathus annulatus*. 18. *Coscinocyathus papillipora*. 19. *Coscinoptycha unilinearis*. 20. *Acanthocyathus apertus*. 21. *Pinacocyathus spicularis*.



22. *Protopharetra graphica*. 23. *Metafungia reticulata*. 24. *Spirocyathus major*. 25. *Spirocyathus speciosus*. 26. *Metaldetes conicus*.



27. *Metacoscinus reteseptatus*. 28. c/f *Metaldetes conicus*. 29. *Metacyathus irregularis*. 30. *Metacyathus Taylori*. 31. c/f *Metaldetes conicus*.



32. *Heterocyathus minor*. 33. ? *Calcareous Alga*. 34. *Heterocyathus minor*. 35. *Uranosphaera polyaster* (Sponge). 36. *Uranosphaera hexaster* (Sponge).

lum; intervallum coefficient 2mm : 8mm. The outer wall has four vertical rows of minute alternating pores per mm. The inner wall has two vertical rows of larger square or polygonal pores per m.m. The intervallum is filled by a fine reticular tissue, each mesh of which measures some .5mm; the elements of this mesh show distinct though irregular traces both of a radial and a longitudinal arrangement, but this is hardly definite enough to justify inclusion of the species in the genus *Spirocyathus*; this arrangement of the intervallum tissue gives in cross section somewhat the appearance of a "Graphic granite," hence the specific name. The specimens appear to continue downwards into a "spitz," without change of character or development of root tissue, as a specimen 3mm. diameter shows the same features, intervallum coefficient 1mm : 1mm. This species is not uncommon in the brown limestone, but appears to have been missed by Taylor; the narrow intervallum at once distinguishes it from his species of *Spirocyathus* and *Protopharetra*.

***Spirocyathus major* (new species). Fig. 24.**

Nearly cylindrical tube with wavy outer wall, the inner wall remaining cylindrical; intervallum coefficient 6mm. : 10mm. The outer wall is for the most part obscured by secondary silicification. Septa curved and anastomosing, with large pores up to 1mm. diameter; they are fairly regular near the outer wall, where they are about 1.7 mm. apart, and become more irregular outwards, with more tendency to curve and anastomose and to become united by synapticulae. The inner wall pores are very large and regular, 1.7mm. across. The species differs from either of Taylor's in having much fewer septa and much larger pores to inner wall. Only one specimen has been found.

***Spirocyathus speciosus* (new species). Fig. 25.**

Conical, with wavy outer wall; intervallum coefficient 4mm : 4mm. The outer wall is for the most part obscured by secondary silicification, but at one concave surface just above an angular wave in the wall uniform circular pores are clearly seen, two to 1mm. The structure is not unlike that of *S. Major*, but on a smaller scale. The pores of inner wall are large and regular, 1mm. across, one or two to intercept; in the upper part of the specimen the width is greater than the depth and they lead upwards and inwards into the central cavity, giving a crescentic section to the pores. The whole structure of the cup is open and delicate and, while it is on a finer scale than *S. major*, the septa are less numerous and the inner wall pores larger than in Taylor's species. No root tissue has been seen. Only one specimen has been found, but it is excellently preserved.

Family METACYATHIDAE (new family).

Taylor describes a species, *Metaldetes cylindricus*, of which he says "I find considerable difficulty in classifying *Metaldetes*"; he places it as an annex to his family *Spirocyathidae*. Taylor's species was founded on unsilicified specimens from a different locality, but we have found no fewer than five new species which are well silicified, and differ from Taylor's species in some respects while agreeing in others. These new forms are of remarkable character and some differ so widely from *Metaldetes* as to require the formation of three new genera, which we have named *Metafungia*, *Metacyathus* and *Metacoscinus*.

We unite *Metaldetes* and the three new genera in a new family, *Metacyathidae*. The essential feature of the family is that whilst possessing radial septa and a central cavity in the upper part of the cup, as in normal *Archaeocyathinae*, these forms, instead of terminating below in a small spitz which retains the normal structure (with or without root tissue), terminate in a comparatively broad base in which the central cavity is obliterated and the septa give place to an irregular mass of vesicular and trabecular tissue.

***Metaldetes conicus* (new species). Figs. 26, 28, 31.**

Upper part a conical tube; intervallum coefficient 7mm. : 14mm. Outer wall has two rows of irregular pores to intercept, partially closed at the outer surface by a finely porous and papillate network. The septa average 1.5mm. apart with pores about .3mm. diameter, 1mm. apart. The inner wall is a delicate spongy network, with a large-pored irregular framework on septal side, supporting a fine-pored irregular net on central cavity side. This spongy pore system is rather similar in the two walls, and is unusual in the *Archaeocyathinae*. The specimen shows the base of a large side branch, 18mm. diameter. Coming to a lower part of the cup, dissepimental tissue is a marked feature, as shown in the lower part of fig. 26. A broken fragment of the same specimen, evidently from a still lower level, has little trace of septa and no central cavity. This fragment is not figured, but another specimen, probably of the same species, is shown in fig. 31. The base of the side branch in the type specimen above referred to consists of similar vesicular tissue. Another specimen, shown in fig. 28, is a still larger upper part of a similar conical cup; intervallum coefficient 10 mm. : 30mm. This is the same or a nearly related species, but scattered dissepimental tissue is still present at this high level.

***Metafungia reticulate* (new genus and species). Fig. 23.**

Conical; upper part with radial septa; intervallum coefficient 6mm. : 15mm. The outer wall has an underlying coarse porous net-work, supporting an outer net with very fine and numerous irregular pores. The septa are about 1mm. apart on average; each consists of a delicate net with very numerous and regularly arranged large circular pores, about .5mm. diameter; from the nodes of this net arise numerous regularly arranged synapticulae, about 1mm. apart, uniting neighboring septa. The inner wall has two rows of regular fairly large polygonal pores to each intercept. The cup terminates below in a base 12 mm. diameter in which septa are largely replaced by an irregular vesicular tissue, which also fills the central cavity; from the base proceed large root masses. Only one specimen has been found.

The conical shape and the smaller size of the pores of inner wall distinguish this species from Taylor's *Archaeofungia Ajax*.

The genus *Metafungia* may be defined as *Metacyathidae* having numerous regularly arranged synapticulae in the upper part of the cup.

***Metacyathus Taylori* (new genus and species). Fig. 30.**

The upper part is a large irregular cylindrical tube, with relatively small central cavity; intervallum coefficient

ent 12mm. : 11mm. The outer surface is rugged and irregular. Outer wall; the outer layer of the cup is occupied by a trabecular and vesicular tissue, and this appears to extend as a spongy network to the outer surface. The numerous septa, a little over 1mm. apart, are straight and clearly defined near the inner wall, and anastomose elsewhere to form a trabecular mesh; both the septa and the trabecular elements are united by thin curved vesicular (dissepimental) laminae; the septa are pierced by numerous large pores, about .5mm. across, one pore to the mm.; the middle of the intervallum is varied in structure, at one point septa may pass without interruption from inner wall to near outer wall, at another trabecular tissue may intervene, giving the following succession—inner wall, septa, trabecular tissue, septa, trabecular tissue, outer wall. The inner wall is a regular well defined layer with two rows of fairly large polygonal pores to each intercept. The base, 20mm. across, is a mass of trabecular and vesicular tissue, without central cavity or well-defined septa, from which proceed root masses of similar tissue; the position of the inner wall is slightly indicated. Only one specimen has been found, but it is a large, handsome and remarkable form, and well defined. We have named it after Professor T. Griffith Taylor.

The genus may be defined as Metacyathidae in which a combination of septal and trabecular masses extends to the upper part of the cup, with strong development of vesicular (dissepimental) tissue.

Metacyathus irregularis (new species). Fig. 29.

A large irregular cone, with wavy outer wall, the inner wall following a similar contour; wide cavity; intervallum coefficient 10mm. : 30mm. The outer wall has an underlying layer of fairly large irregular pores, usually two rows to each intercept, which are masked at the surface by a finer network and an outgrowth of fine processes. The septa are straight and delicate, a little over 1mm. apart, and there is a great development of fine dissepimental tissue which often interrupts and confuses the septa; the septa are easy to expose in transverse and tangential sections, but extremely difficult to expose in radial section; a small area darkened by manganese obscurely indicates large pores (fig. 29c). The specimen is obscured by secondary silicification and no satisfactory trace of the inner wall was exposed; its place is taken in places by a thin structureless membrane (? secondary silicification). A length of 90mm. is preserved but the base is missing; we expect that this, when found, will agree with other members of the family. Two large root-like masses of vesicular and trabecular tissue occur in the lower part of the fragment. Only one specimen has been found.

Taylor's species *Archaeocyathus dissepimentalis*, though not identical with any of our species, has points of resemblance to *Metaldetes conicus* and *Metacyathus irregularis*, and may possibly be the upper part of a member of the Metacyathidae.

Metacoscinus reteseptatus (new genus, new species). Fig. 27.

The species presents a very remarkable combination of features. It is a conical cup; the upper part has numerous straight and regular septa, about 1mm. apart; intervallum coefficient 5mm. : 15mm.; the external surface is

waved by annular swellings, the inner wall remaining unaffected. The outer wall is a delicate network of irregular polygonal pores, two or three to 1mm. The septa are an open net of large polygonal pores, irregular in size; they are perfectly straight and regular, without synapticalae or dissepiments. Tabulae of an unusual character are present in the lower part of the cup, but, if present in the upper part, they must be at remote intervals; the tabulae are pierced by numerous small circular pores between which are numerous round as well as irregular tubercles, proceeding from the upper and lower surfaces of the tabulae; many of these tubercles arch and unite and become continuous with the septal network. The lower part of the cup at a diameter of 7mm. loses its central cavity; the septa become irregular; and the whole area becomes filled with a mass of vesicular tissue; excrescences of the nature of buds or roots are present. The inner wall, in the upper regular part of the cup, is a delicate open network with large pores, two rows to each intercept.

Several specimens have been found. The upper part strongly resembles Taylor's *Archaeocyathus retesepta*, but we have not felt justified in claiming identity without Professor Taylor's sanction and direct comparison of the type specimens. The probable relationship is indicated by our specific name "*reteseptatus*"; and, should the identity be admitted, the name would be *Metacoscinus retesepta* (Taylor).

The genus may be defined as Metacyathidae with straight net-like septa in the upper part, and with tabulae present.

Family HETEROCYATHIDAE (new family). Figs. 32, 34.

The family is founded on two remarkable fragments which present some points of semblance to *Archaeocyathinae*, but in which a new feature is introduced, viz., the growth of the walls from radiating centres. In one of these specimens, fig. 32, two walls are present, with an intervallum distance of 5mm., the walls being connected by a few coarse and irregular scattered rods or spicules. The specimen is part of a cone or cylinder some 50mm. diameter, fig. 32b and the lower part of fig. 32a representing the outer wall, and fig. 32c and the upper part of fig. 32a representing the inner wall. Both walls show a series of straight or curved lines of tubercles radiating from centres some 6mm. apart. The tubercles of the outer wall are larger and longer than those of the inner wall, and they show a tendency to incline from the centres of radiation and to anastomose. The preservation and silicification of this specimen may be somewhat anomalous, as the limestone matrix has indications of differentiation shown by the lines of shading in fig. 32a; it is therefore possible that the tubercles may represent casts in secondary silica of an originally porous structure; such casts are not uncommon in *Archaeocyathinae* from the locality.

The porous structure of the other specimen, fig. 34, is quite definite; only a single wall, practically flat, is preserved; the state of preservation and silicification is of the normal type. The pores, spaced on an average of two to 1mm., are in radiating lines separated by ridges which are most prominent near the centres of radiation; these centres are about 15mm. apart. There are a few knobs on the exposed surface which might possibly represent the bases of bars connecting this to a second wall. Although the evidence is far from conclusive, we are inclin-

ed to associate the two specimens; if this is justifiable, the double wall of fig. 32, and the porous structure of fig. 34, suggest an aberrant type of the Archaeocyathinae. We propose the following names:—

Heterocyathus minor (new genus and species). Fig. 32.

Heterocyathus major (new species). Fig. 34.

We hope that further material may be forthcoming to fully define the structure of these interesting forms.

PORIFERA. Figs. 35, 36.

Besides isolated spicules, we have found more or less complete specimens of two interesting sponges. We are not aware that these forms have been previously described from foreign localities, and, not being in a position to examine the literature, name them provisionally as follows. **Uranosphaera polyaster** (new genus and species). Fig. 35.

The specimen is a segment of a hollow sphere, which would have been about 27mm. in diameter. There appears to be an opening, 8mm. diameter, surrounded by a thickened rim. The wall is composed of spicular elements, each of which has the form of a star with about a dozen rays; many of the rays branch into two or three points (which is not properly brought out in the sketch). Each spicule is convex on the outer and concave on the inner surface; as far as we can judge the rays do not depart much from the curved surface of the wall, and the spicules are rather of the nature of bodies of two dimensions than of spherical bodies with rays proceeding in all directions. The spicules are about 5mm. apart, centre to centre, and, as they may be 7mm. or more in diameter, the rays of neighbouring spicules often interdigitate or cross one another. The lower sketch shows the deeply etched

edge of the fragment from the inner or concave surface. Only one specimen has been found; but another fragment is very similar, with smaller spicules.

Uranosphaera hexaster (new species). Fig. 36.

The specimen is a segment of a hollow sphere, about 30 mm. diameter. The spicules are much smaller than those of *U. polyaster*; they are about 2 to 3mm. diameter, and are less uniform in size; they have six rays and, for the most part, neighboring spicules are separated by an interval of 1 or 2mm; this feature is not, however, constant, as some are in contact, and in other cases minute spicules of similar form can be detected between the larger ones. Whether an opening was present, as in the previous species, is uncertain.

? CALCAREOUS ALGA. Fig. 33.

We add a sketch of a branching organism which may be a calcareous Alga. It is interesting as being one of the very few organisms, apart from Archaeocyathinae, sponge spicules and a Brachiopod, which we have found in this material.

Besides the Archaeocyathinae herein described we have a good many specimens from Beltana which await further elucidation, as well as one or two interesting forms which have come to light while this paper was in preparation for the press. We hope to be able to deal with these at a later date, together with several species from other localities in which we have collected, and also to comment on some of Taylor's species as to which our material furnishes fresh information.



